XC8102 Series

ETR2502-008

Load Switch with Low On-Resistance (Current Limit 400mA)

■GENERAL DESCRIPTION

The XC8102 series is a low ON resistance load switch IC with ON/OFF control and output current protection which integrates a P-channel MOSFET.

By connecting the XC8102 to the output pin of a step-down DC/DC converter, the CE pin controls ON/OFF for each distribution switch to deliver power per requirements and maximize total power efficiency. As a result, the XC8102 helps to extend battery life and product operation time.

The series contains a current limit and protection circuit so these are not required externally unlike discrete circuit solutions where MOSFETs and resistors are used.

When a low signal is input to the CE pin, the series enters stand-by mode. Even where a load capacitor is connected to the output pin during stand-by, the electric charge stored at the load capacitor is discharged through the internal switch. As a result, the V_{OUT} pin voltage falls quickly to the V_{SS} level.

The series contains over current protection with fold-back current circuitry which operates as over current protection and short circuit protection for the output pin.

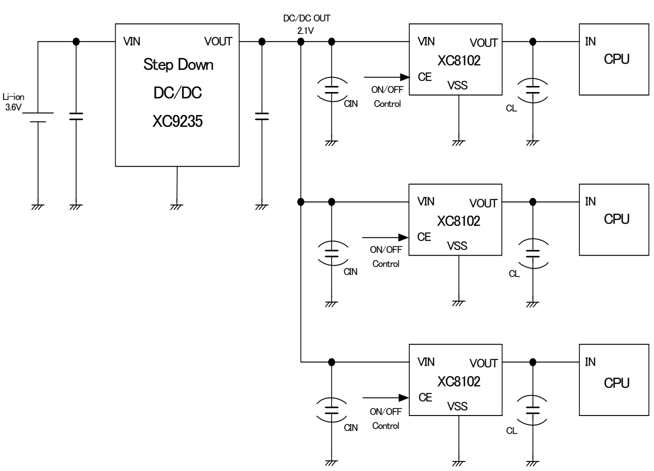
■APPLICATIONS

- Mobile phones, Smart phones
- Digital still cameras, Digital video cameras
- Portable game consoles
- Portable equipment

■FEATURES

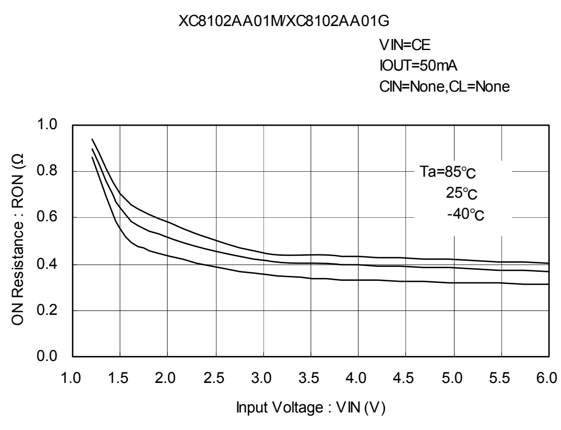
On Resistance	: 0.28Ω@ V_{IN}=6.0V (TYP.) 0.31Ω@ V_{IN}=4.0V (TYP.) 0.35Ω@ V_{IN}=2.9V (TYP.) 0.52Ω@ V_{IN}=1.8V (TYP.) 0.60Ω@ V_{IN}=1.5V (TYP.) 0.80Ω@ V_{IN}=1.2V (TYP.)
Input Voltage Range	: 1.2V～6.0V
Power Consumption	: 3.0μA@ V_{IN}=1.2V 3.6μA@ V_{IN}=2.9V 4.0μA@ V_{IN}=6.0V
Stand-by Current	: 0.1μA
Protection Circuit	: Current limit(Output Current) 400mA (1.8≦V_{IN}≦6.0V) Short-circuit Protection, Short current= 30mA (TYP.)
ON/OFF Function	: Active High Enable High-Speed Discharge Function
Operating Ambient Temperature	: -40℃～+85℃
Packages	: USP-4,SSOT-24, SOT-25 USPN-4
Environmentally Friendly	: EU RoHS Compliant, Pb Free

■TYPICAL APPLICATION CIRCUIT

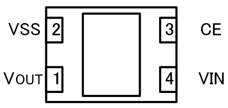


■ TYPICAL PERFORMANCE CHARACTERISTICS

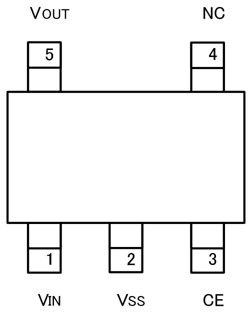
●On Resistance vs. Input Voltage



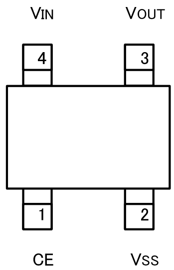
■PIN CONFIGURATION



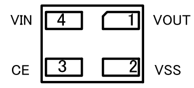
USP−4
(BOTTOM VIEW)



SOT−25
(TOP VIEW)



SSOT−24
(TOP VIEW)



USPN−4
(BOTTOM VIEW)

*The heat dissipation pad of the USP-4 package is recommended to solder as shown in the recommended mount pattern and metal mask pattern for mounting strength. The heat dissipation pad should be electrically opened or connected to the V_{SS} (No. 2) pin.

■PIN ASSIGNMENT

PIN NUMBER				PIN NAME	FUNCTIONS
USP-4	SOT-25	SSOT-24	USPN-4		
4	1	4	4	V_{IN}	Power Input
1	5	3	1	V_{OUT}	Output
2	2	2	2	V_{SS}	Ground
3	3	1	3	CE	ON/OFF Control
—	4	—	-	NC	No Connection

■PRODUCT CLASSIFICATION

●Ordering Information

XC8102①②③④⑤⑥-⑦(*1)

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	CE pin logic	A	CE High active
②	C_L Discharge Function	A	Output capacitor (C_L) auto-discharge function integrated
③④	Internal Standard Number	01	Fixed
⑤⑥-⑦(*1)	Packages (Order Unit)	GR-G	USP-4 (3,000/Reel)
		MR-G	SOT-25 (3,000/Reel)
		NR-G	SSOT-24 (3,000/Reel)
		7R-G	USPN-4 (5,000/Reel)

(*1) The “-G” suffix denotes Halogen and Antimony free as well as being fully RoHS compliant.

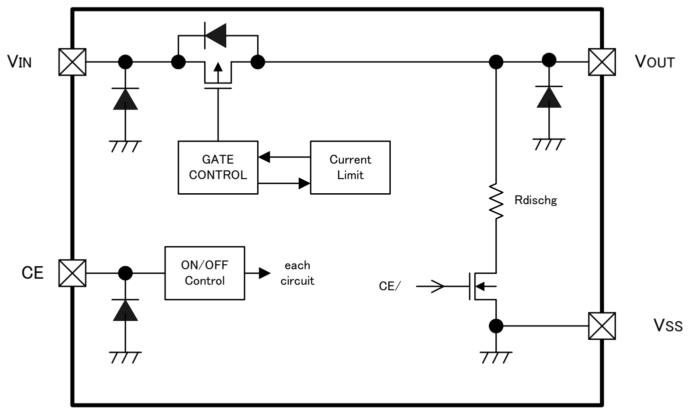
■FUNCTION CHART

SERIES	CE	IC OPERATIONAL STATUS ON/OFF
XC8102AA01	H	ON
	L	OFF
	OPEN	Undefined state

H = High Level
L = Low Level

* CE pin should not be left open.

■BLOCK DIAGRAM



XC8102AA Series

* Diodes inside the circuit are an ESD protection diode and a parasitic diode.

■ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	-0.3～+6.5	V
Output Current		I_{OUT}	850(*1)	mA
			750(USPN-4)(*1)	
Output Voltage		V_{OUT}	-0.3～V_{IN}	V
CE Input Voltage		V_{CE}	-0.3～+6.5	V
Power Dissipation	USP-4	Pd	120	mW
	SSOT-24		150	
	SOT-25		250	
	USPN-4		100	
Operating Ambient Temperature		Topr	-40～+85	°C
Storage Temperature		Tstg	-55～+125	°C

(*1) Please make sure that I_{OUT} is less than Pd/ (V_{IN}-V_{OUT})

■ELECTRICAL CHARACTERISTICS

●XC8102 Series

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUITS
Input Voltage	V_{IN}		1.2	-	6.0	V	-
On Resistance (SSOT-24/USPN-4)	R_{ON}	V_{IN} =6.0V, V_{CE}=V_{IN}	-	0.28	0.425	Ω	①
		V_{IN} =4.0V, V_{CE}=V_{IN}	-	0.31	0.475		
		V_{IN} =2.9V, V_{CE}=V_{IN}	-	0.35	0.475		
		V_{IN} =1.8V, V_{CE}=V_{IN}	-	0.52	0.625		
		V_{IN} =1.5V, V_{CE}=V_{IN}	-	0.60	0.80		
		V_{IN} =1.2V, V_{CE}=V_{IN}	-	0.80	1.60		
On Resistance (SOT-25/USP-4)	R_{ON}	V_{IN} =6.0V, V_{CE}=V_{IN}	-	0.35	0.475	Ω	①
		V_{IN} =4.0V, V_{CE}=V_{IN}	-	0.38	0.525		
		V_{IN} =2.9V, V_{CE}=V_{IN}	-	0.43	0.525		
		V_{IN} =1.8V, V_{CE}=V_{IN}	-	0.59	0.675		
		V_{IN} =1.5V, V_{CE}=V_{IN}	-	0.67	0.85		
		V_{IN} =1.2V, V_{CE}=V_{IN}	-	0.87	1.65		
Supply Current	I_{DD}	V_{IN} =6.0V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	4.0	7.0	μA	②
		V_{IN} =4.0V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	3.8	6.5		
		V_{IN} =2.9V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	3.6	6.3		
		V_{IN} =1.8V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	3.4	5.7		
		V_{IN} =1.5V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	3.2	5.5		
		V_{IN} =1.2V, V_{CE}=V_{IN}, V_{OUT}=OPEN	-	3.0	4.9		
Stand-by Current	I_{STBY}	V_{IN} =6.0V, V_{CE}=V_{SS}, V_{OUT}=OPEN	-	0.01	0.10	μA	②
Switch Leakage Current	I_{LEAK}	V_{IN} =6.0V, V_{CE}=V_{SS}, V_{OUT}=0V	-	0.01	0.10	μA	②
Current Limit	I_{LIM}	V_{IN}≧2.9V, V_{OUT} = V_{IN} -0.8V	400	480	-	mA	①
		1.8V≦V_{IN}<2.9V, V_{OUT} = V_{IN} -0.6V	400	480	-		
		1.5V≦V_{IN}<1.8V, V_{OUT} =1.2V	200	-	-		
		1.2V≦V_{IN}<1.5V, V_{OUT} =1.0V	90	-	-		
Short Circuit Current	I_{SHORT}	V_{CE}=V_{IN}, V_{OUT}=0V	-	30	75	mA	①
CE High Level Voltage	V_{CEH}		1.1	-	6.0	V	③
CE Low Level Voltage	V_{CEL}		-	-	0.3	V	③
CE High Level Current	I_{CEH}	V_{CE}=V_{IN}	-0.1	-	0.1	μA	③
CE Low Level Current	I_{CEL}	V_{CE}=V_{SS}	-0.1	-	0.1	μA	③
C_L Auto-Discharge Resistance	R_{DCHG}	V_{IN}=4.0V, V_{OUT}=4.0V, V_{CE}=V_{SS}	380	480	570	Ω	④
Turn On Time (*1)	$t_{DLY(ON)}$	V_{IN} =4.0V, V_{CE}=0.3V→1.2V, R_L=80Ω, without C_{IN}, C_L	-	8.5	18	μs	⑤
Turn Off Time (*2)	$t_{DLY(OFF)}$	V_{IN} =4.0V, V_{CE}=1.2V→0.3V, R_L=80Ω, without C_{IN}, C_L	-	3.0	7.5	μs	⑤

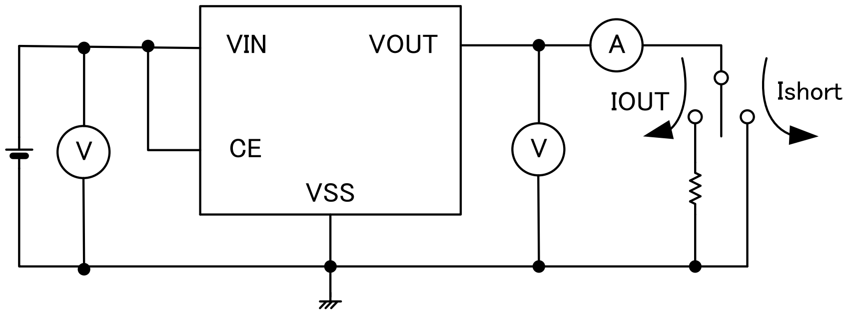
NOTE:

*1: Time to reach 90% of V_{OUT} after V_{CE} entering the V_{CEH} threshold.

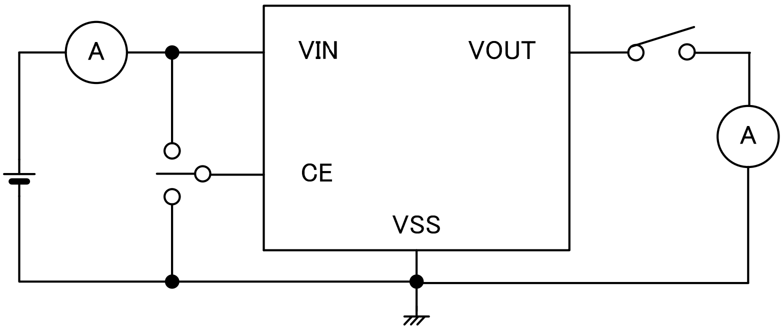
*2: Time to fall to 10% of V_{OUT} after V_{CE} entering the V_{CEL} threshold.

■TEST CIRCUITS

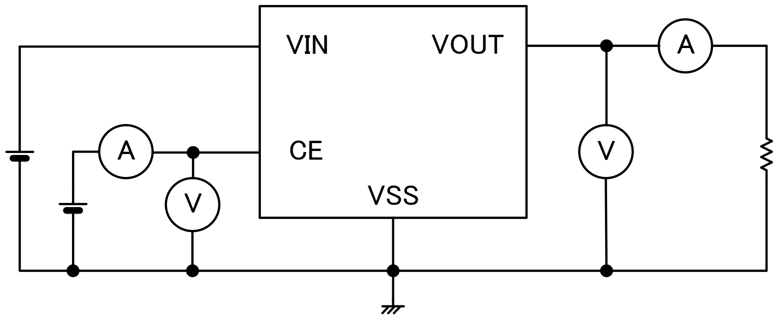
Circuit ①



Circuit ②

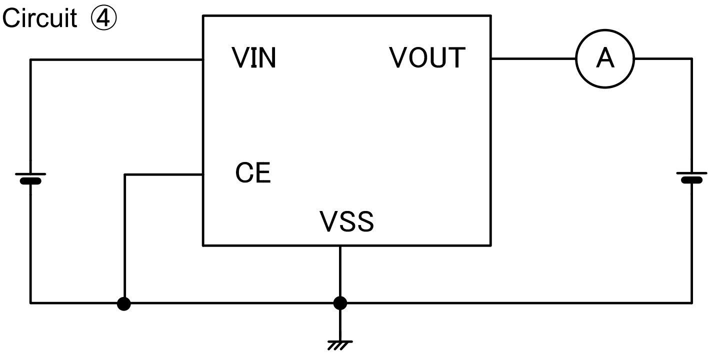


Circuit ③

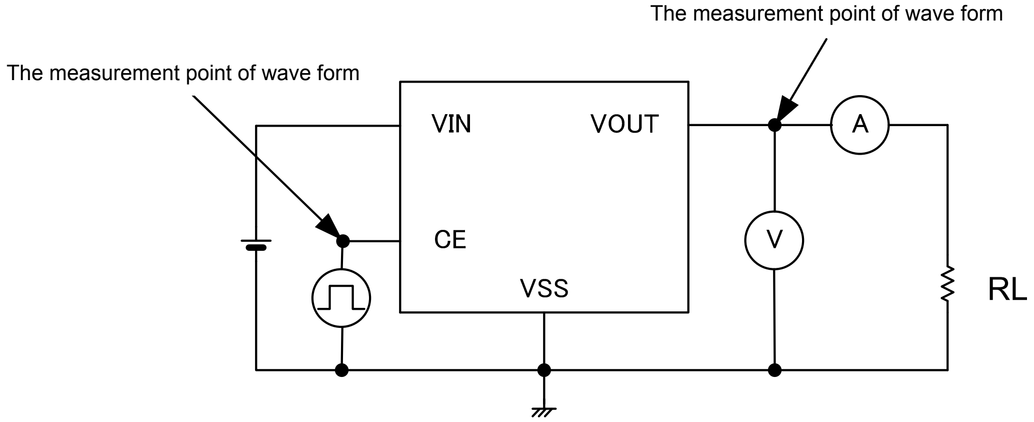


■TEST CIRCUITS (Continued)

Circuit ④



Circuit ⑤



■OPERATIONAL EXPLANATION

<CE Pin>
The XC8102 enables an output P-channel MOSFET switch and the IC internal circuitry to turn off by the signal to the CE pin. In the shutdown mode, the V_{OUT} pin will be pulled down to the V_{SS} by the C_L auto-discharge function.
The output voltage becomes unstable when the CE pin is opened. If the input voltage to the CE pin is within the specified threshold voltages, the logic is fixed and the XC8102 will operate normally. However, supply current may increase as a result of the shoot-through current of internal circuitry when the medium level voltage is input to the CE pin.

＜Input/Output Capacitor＞
The XC8102 works well without an input and output capacitors. Also, an output capacitor of the power source can be used as an input capacitor of the XC8102 and a bypass capacitor of the driving IC can be used as an output capacitor of the XC8102.

<C_L Auto-Discharge Function>
The XC8102AA contains a C_L auto-discharge resistor and an N-channel transistor between the V_{OUT} pin and the V_{SS} pin. The device quickly discharge the electric charge in the output capacitor (C_L) when a low signal to the CE pin is input to turn off a whole IC circuit. The C_L auto-discharge resistance is set at 480Ω (V_{OUT}=4.0V TYP. @ V_{IN}=4.0). Discharge time of the output capacitor (C_L) is determined by a C_L auto-discharge resistor value (Rdischg) and an output capacitor value. Time constant τ is defined as (τ = C x Rdischg). Output voltage after starting discharge can be calculated by the following formula.

$$V = V_{OUT} \times e^{-t/\tau}, \quad \text{or} \quad t = \tau \ln (V_{OUT} / V)$$

V: Output voltage after starting discharge,
V_{OUT}: Output voltage,
t : Discharge time,
τ : Output discharge resistor value Rdischg × Output capacitor (C_L) value C

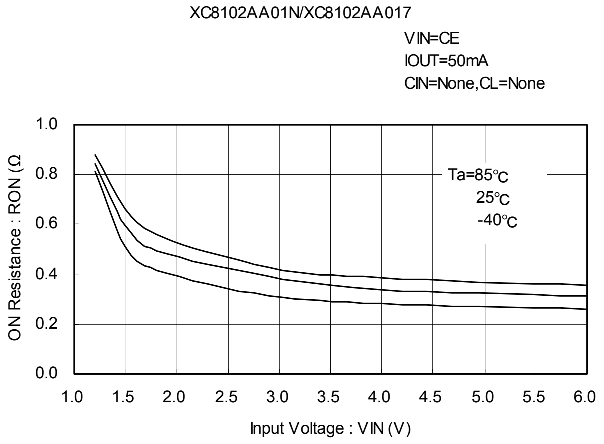
<Current Limiter, Short-Circuit Protection>
The XC8102 series contains a constant current limiter and fold-back current circuitry. The constant current limiter operates to limit output current and the fold-back current circuitry operates as short circuit protection for the output pin.
When the load current reaches the limit current, the constant current limiter operates and the output voltage drops. The output voltage further, then the fold-back current circuitry operates to decrease the output current. When the output pin is short-circuited to the ground, the output current drops and maintains a flow about 30mA.

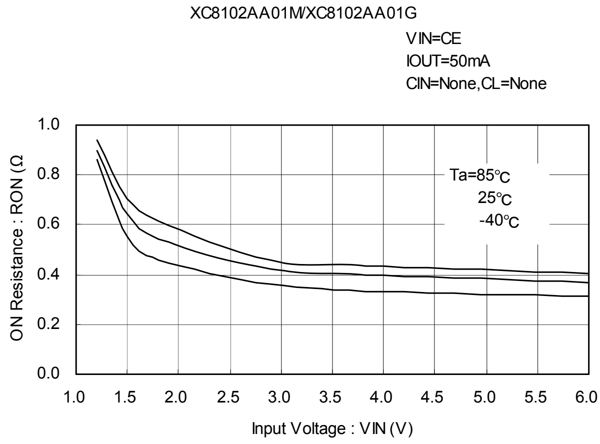
■NOTES ON USE

1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. The X8102 goes into an undefined operation when the CE pin is left open. The CE pin shall be tied to low or high level.
3. V_{OUT} pin voltage should not be applied beyond the V_{IN} pin voltage.
   The IC may get damage due to the reverse current toward the V_{IN} pin.
4. The XC8102 has constant current start-up.
   Please keep the start-up sequence to draw load current after raising the output voltage.
5. Current limit function is integrated. However, power dissipation may be beyond the limit before starting a fold-back current protection when used in high temperature. For the power dissipation of each package, please refer to the graphs of Package Power vs. Operating Temperature in page 15 to 18.
6. Torex places an importance on improving our products and their reliability.
   We request that users incorporate fail-safe designs and post-aging protection treatment when using Torex products in their systems.

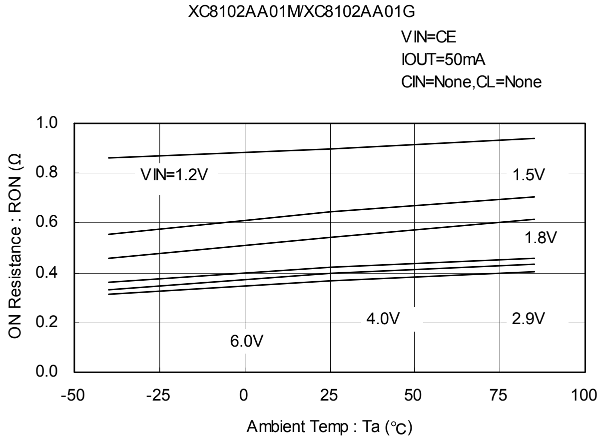
■TYPICAL PERFORMANCE CHARACTERISTICS

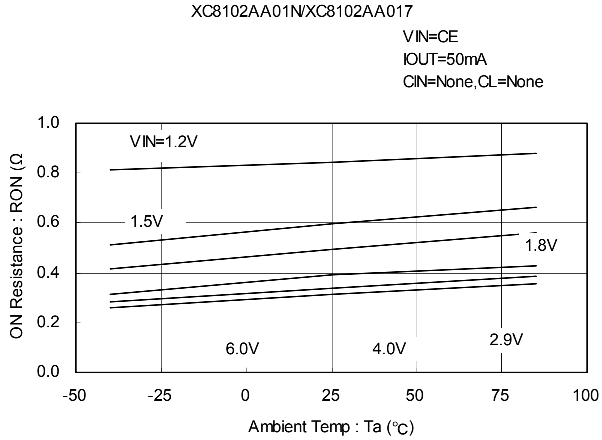
(1) ON Resistance vs. Input Voltage



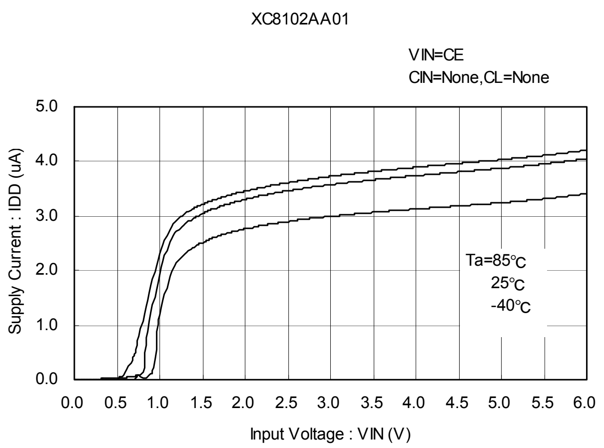


(2) ON Resistance vs. Ambient Temperature

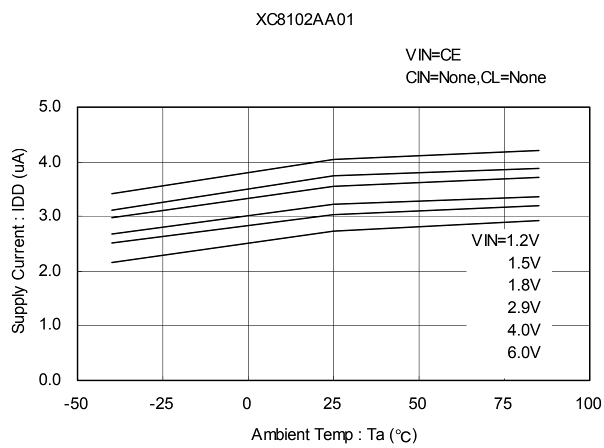




(3) Supply Current vs. Input Voltage

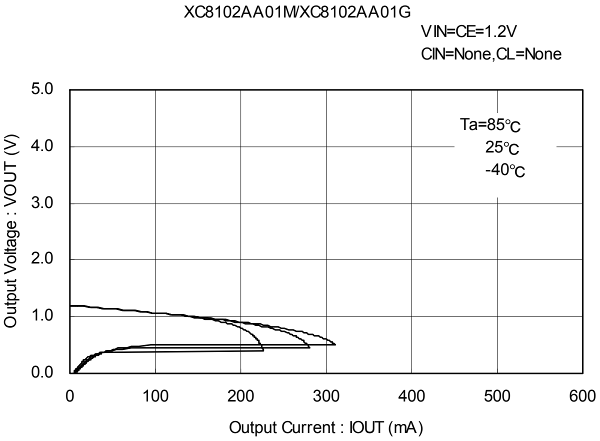


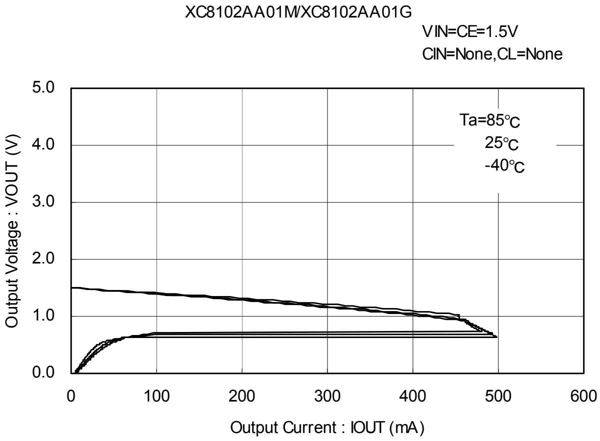
(4) Supply Current vs. Ambient Temperature

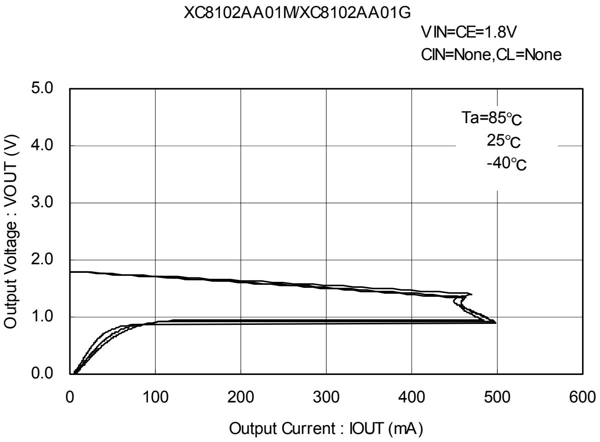


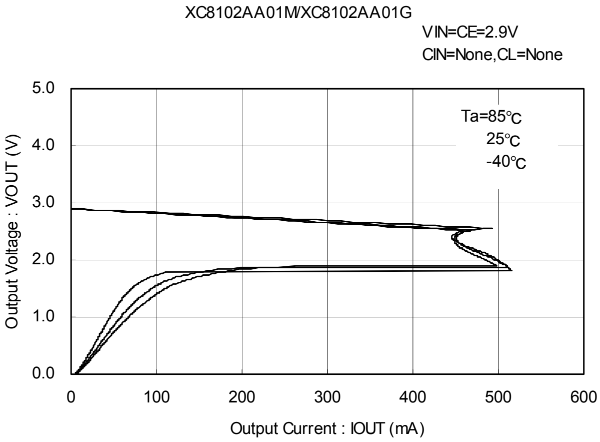
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

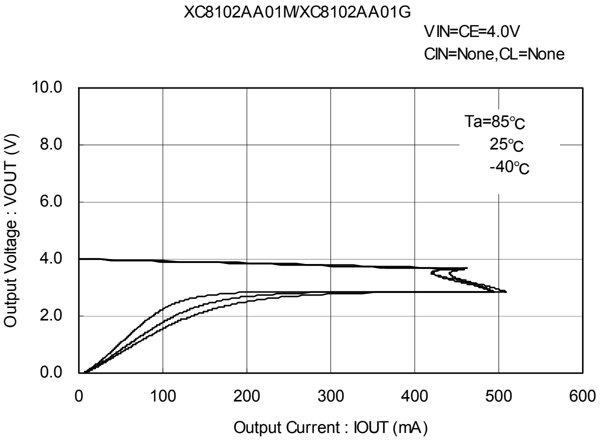
(5) Output Voltage vs. Output Current

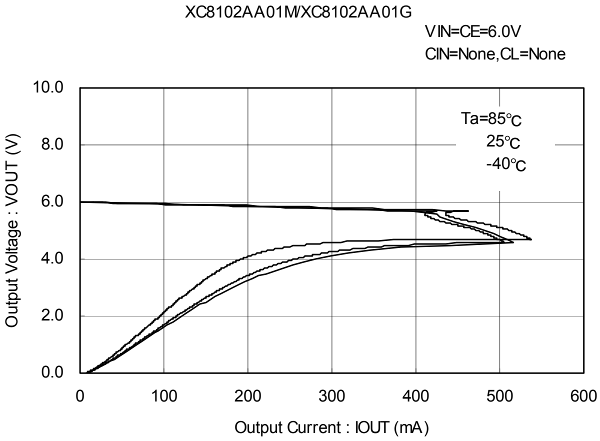






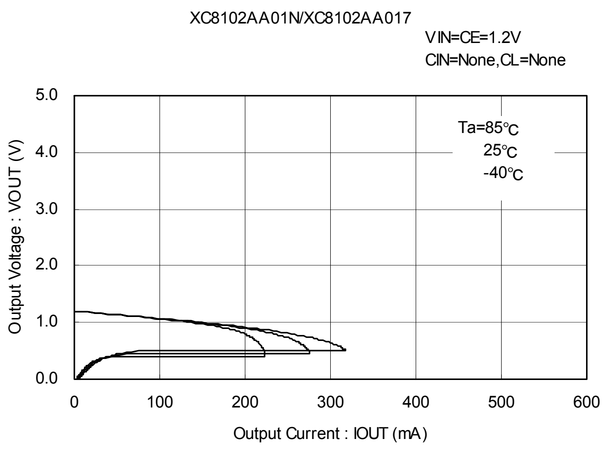


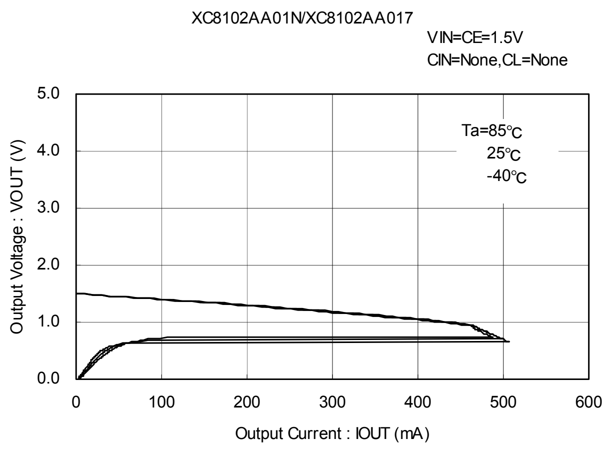


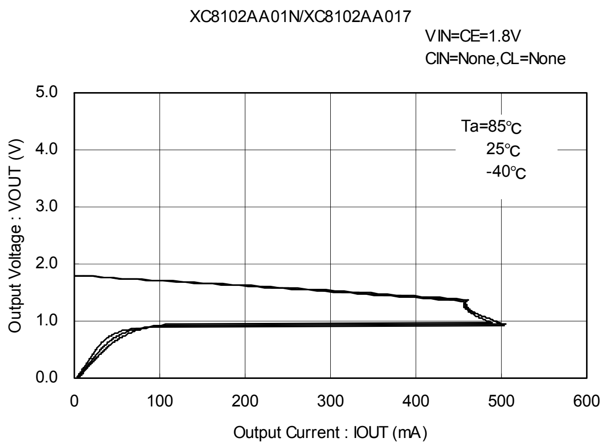


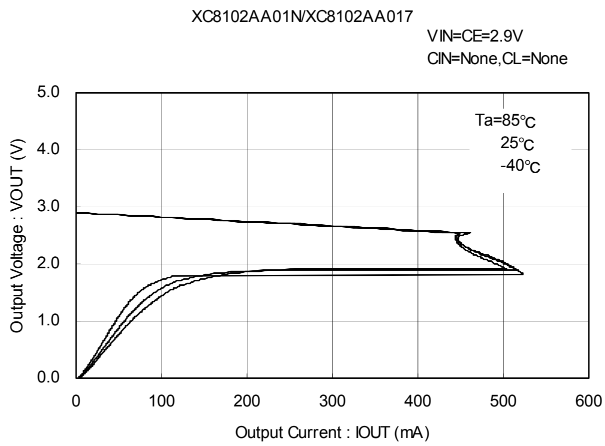
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

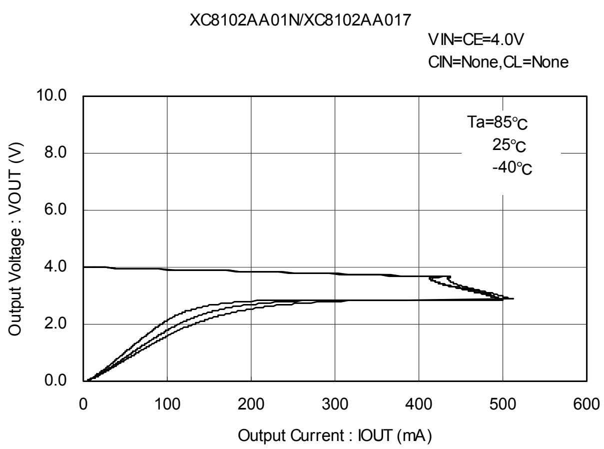
(5) Output Voltage vs. Output Current

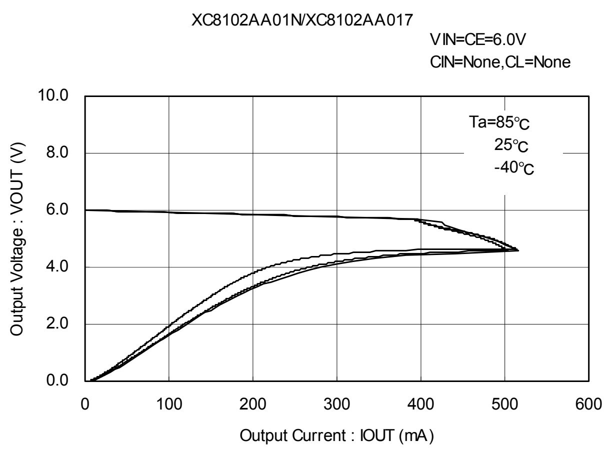






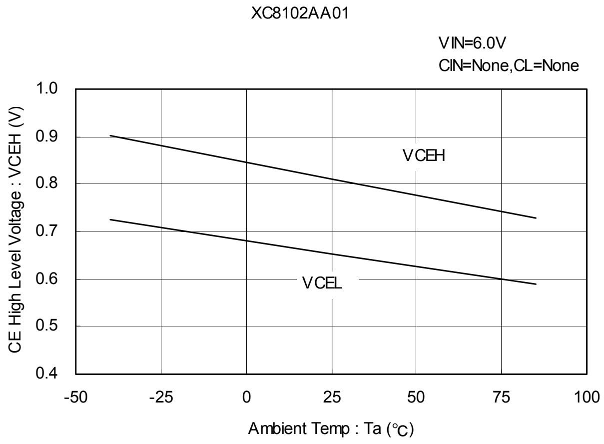




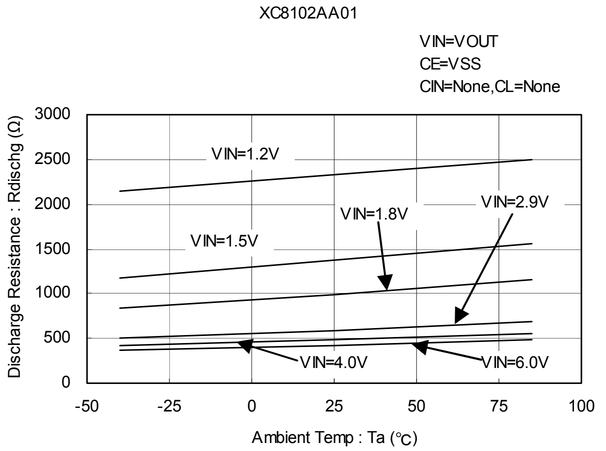


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

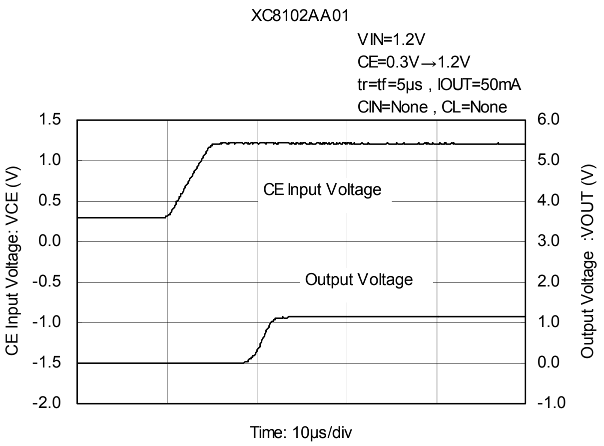
(6) CE Threshold Voltage vs. Ambient Temperature

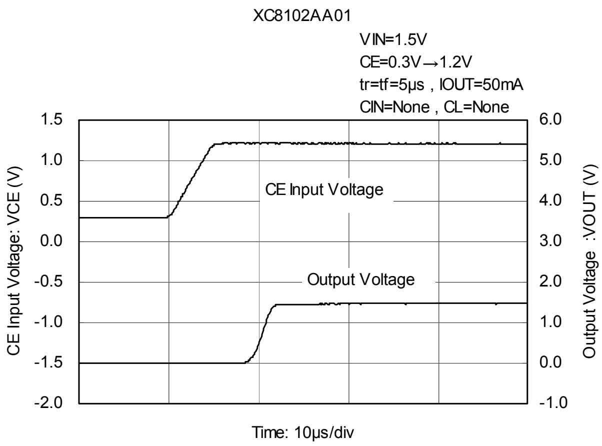


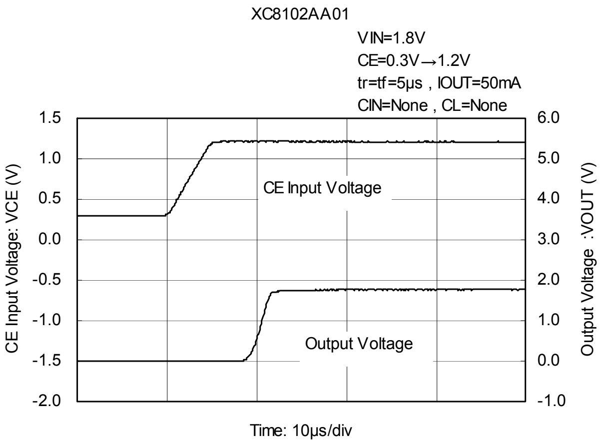
(7) CL Discharge Resistance vs. Ambient Temperature

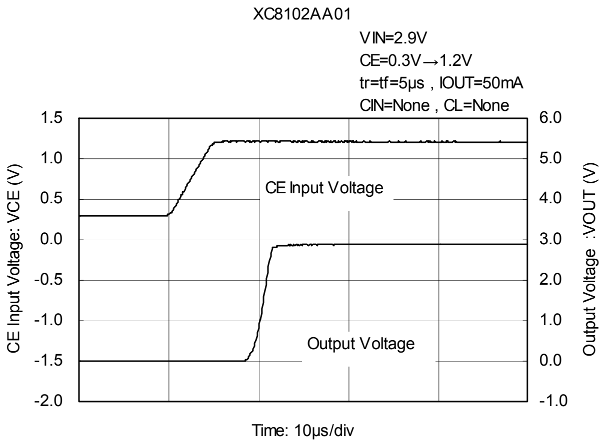


(8) Output Turn-on Time with CE



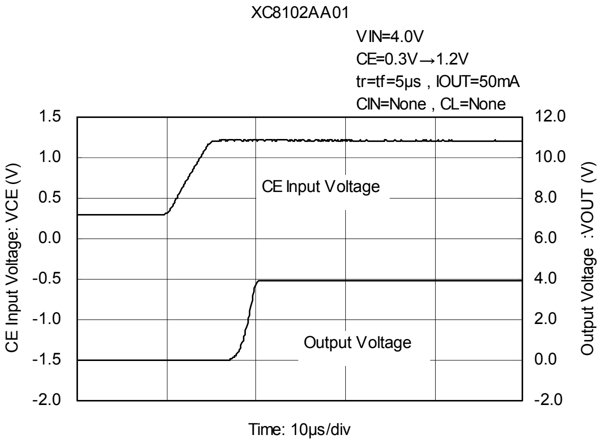


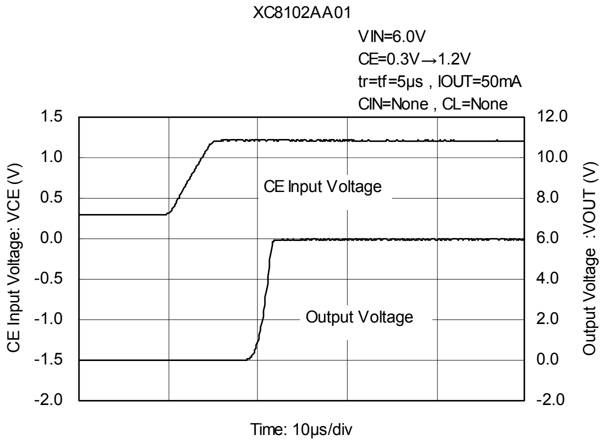




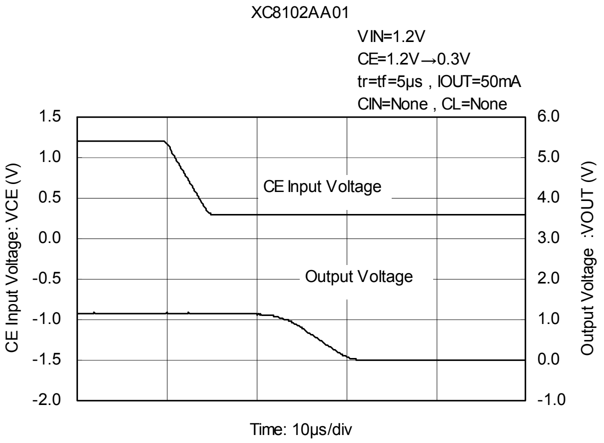
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

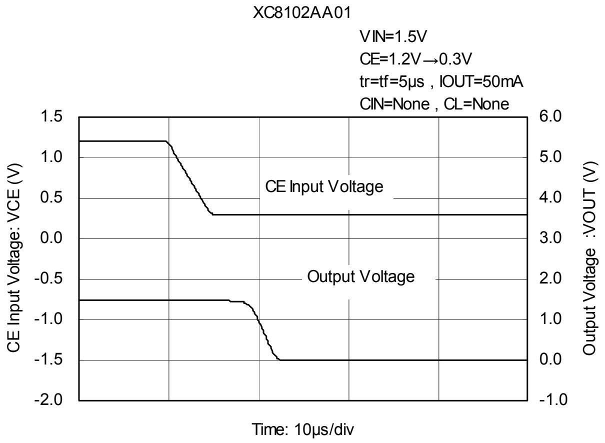
(8) Output Turn-on Time with CE (Continued)

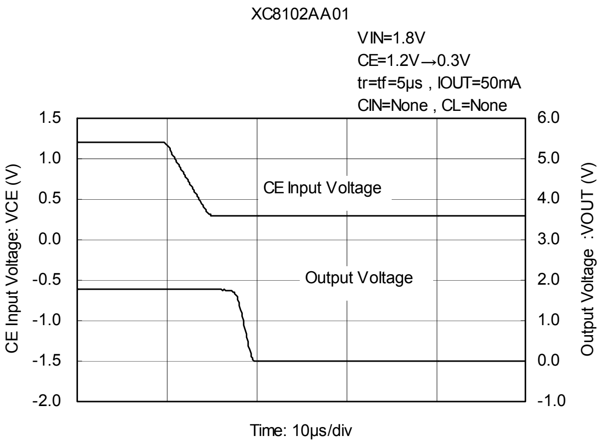


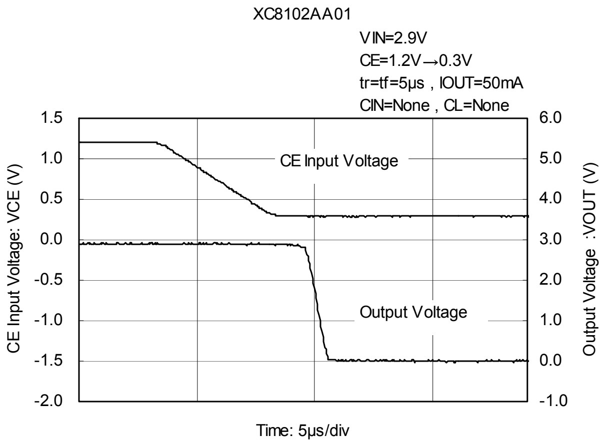


(9) Output Turn-off Time with CE



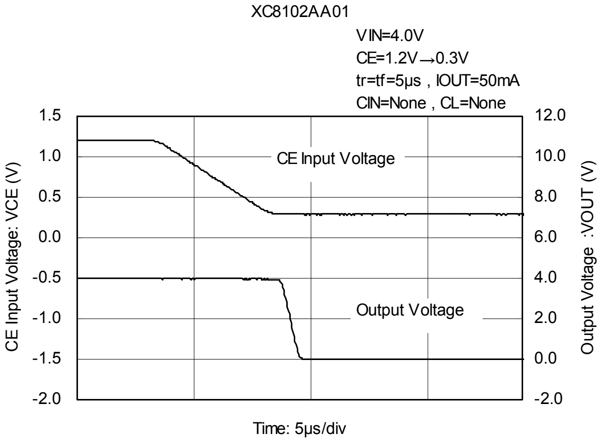


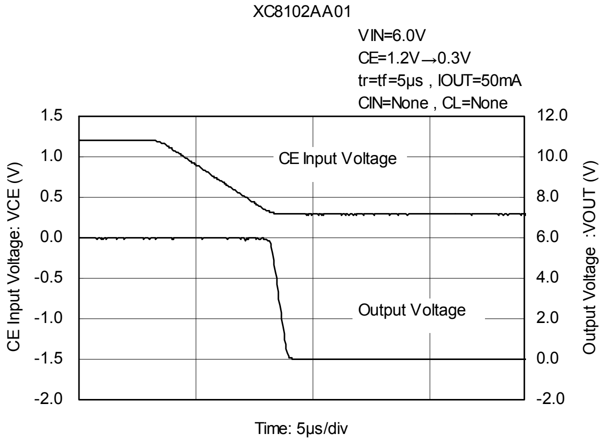




■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

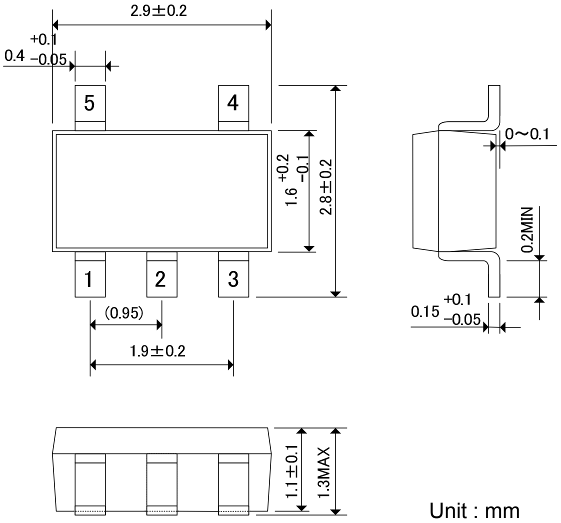
(9) Output Turn-off Time with CE (Continued)





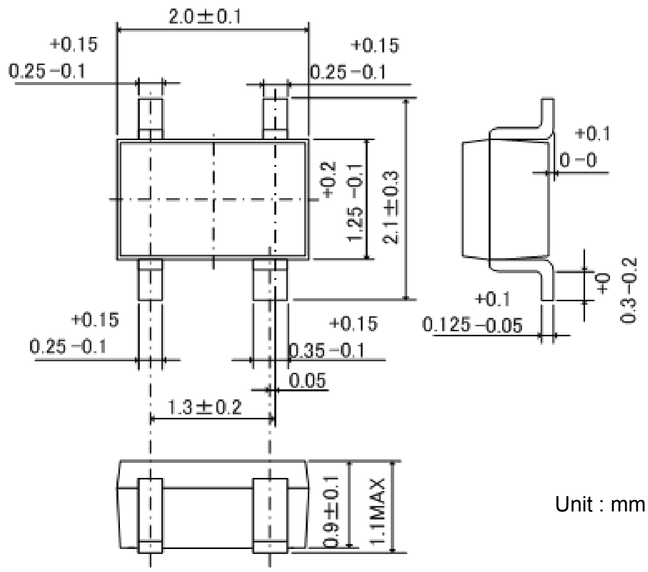
■PACKAGING INFORMATION

●SOT-25



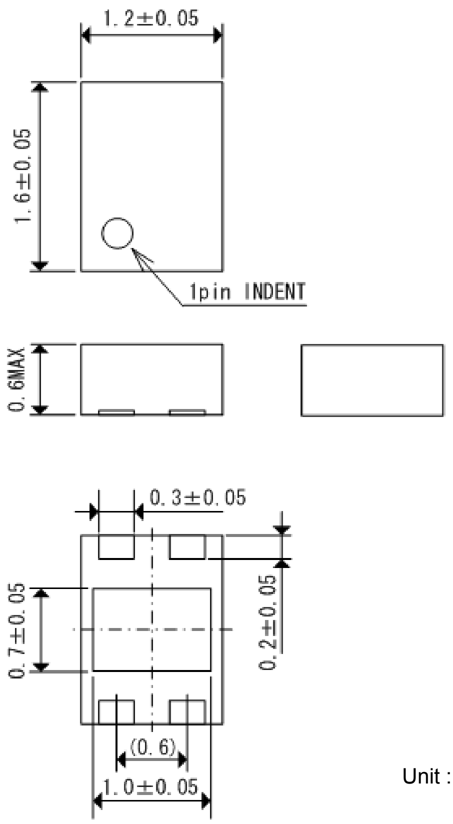
Unit : mm

●SSOT-24



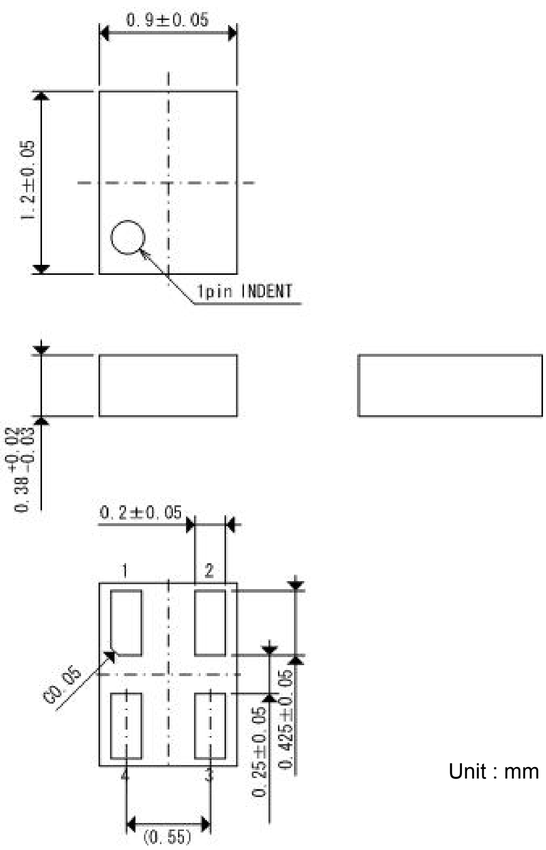
Unit : mm

●USP-4



Unit : mm

●USPN-4



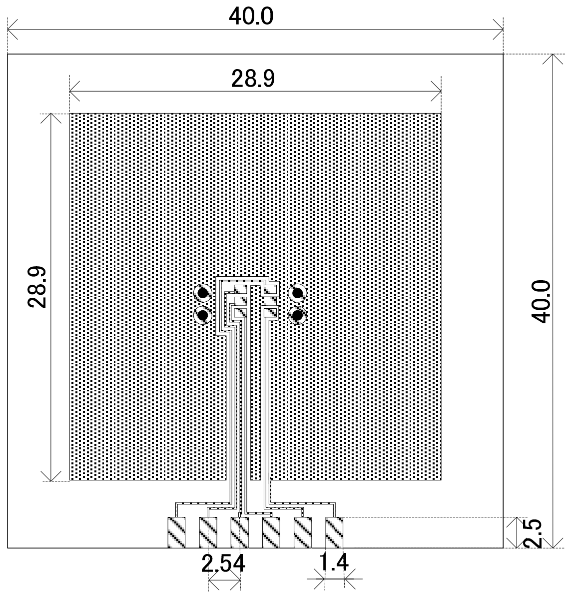
Unit : mm

■PACKAGING INFORMATION (Continued)

● SOT-25 Power Dissipation

Power dissipation data for the SOT-25 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)
   Condition: Mount on a board
   Ambient: Natural convection
   Soldering: Lead (Pb) free
   Board: Dimensions 40 x 40 mm (1600 mm^2 in one side)
   Copper (Cu) traces occupy 50% of the board area
   In top and back faces
   Package heat-sink is tied to the copper traces
   (Board of SOT-26 is used)
   Material: Glass Epoxy (FR-4)
   Thickness: 1.6 mm
   Through-hole: 4 x 0.8 Diameter

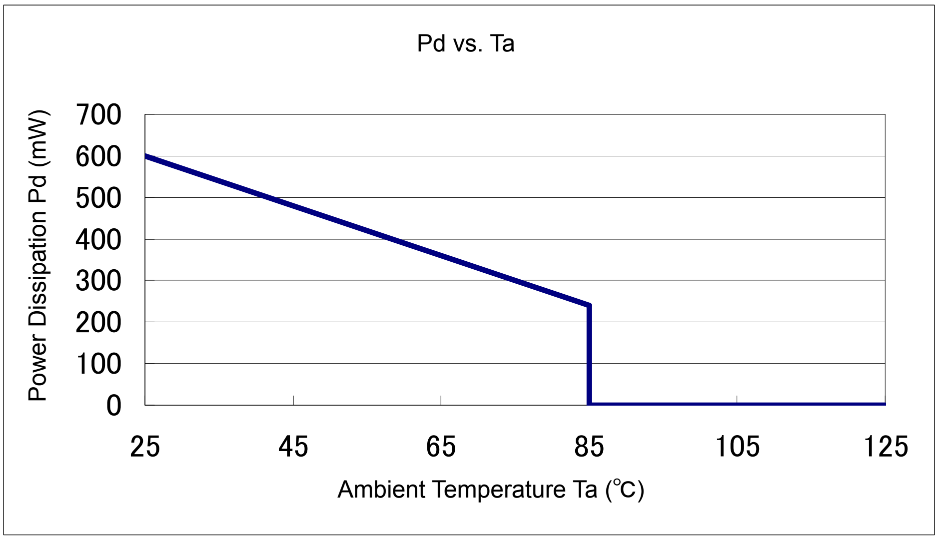


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	600	166.67
85	240	

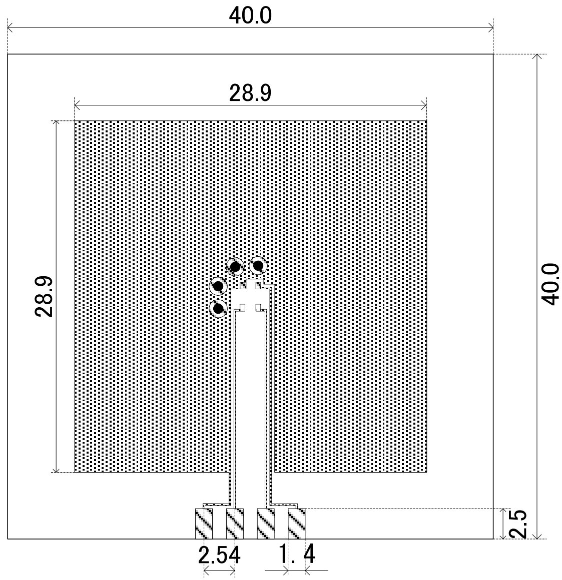


■PACKAGING INFORMATION (Continued)

- SSOT-24 Power Dissipation

Power dissipation data for the SSOT-24 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)
   Condition: Mount on a board
   Ambient: Natural convection
   Soldering: Lead (Pb) free
   Board: Dimensions 40 x 40 mm (1600 mm^2 in one side)
   Copper (Cu) traces occupy 50% of the board area
   In top and back faces
   Package heat-sink is tied to the copper traces
   Material: Glass Epoxy (FR-4)
   Thickness: 1.6 mm
   Through-hole: 4 x 0.8 Diameter

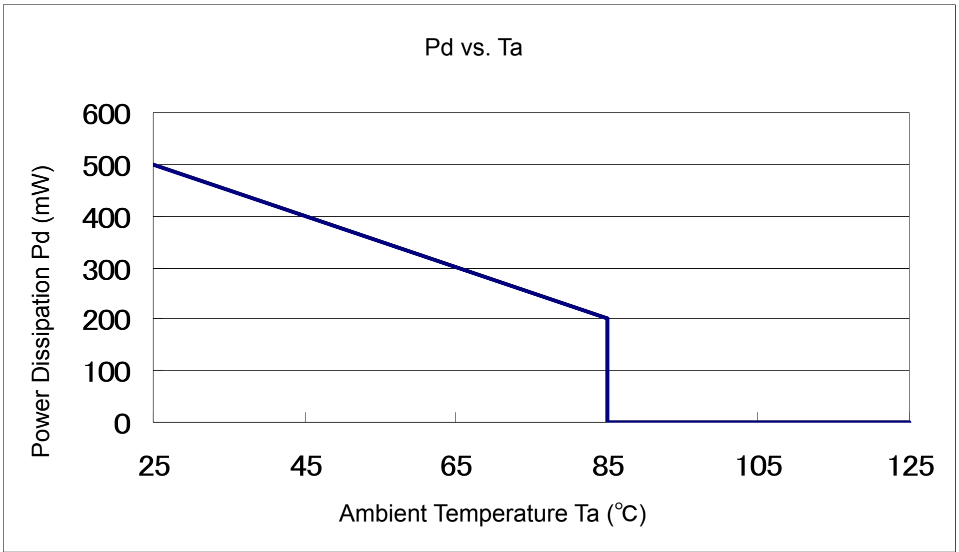


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

Ambient Temperature（℃）	Power Dissipation Pd（mW）	Thermal Resistance (℃/W)
25	500	200.00
85	200	

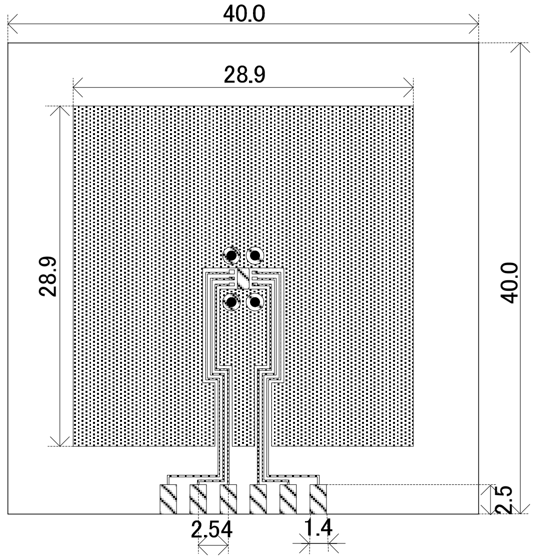


■PACKAGING INFORMATION (Continued)

● USP-4 Power Dissipation

Power dissipation data for the USP-4 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)
   Condition: Mount on a board
   Ambient: Natural convection
   Soldering: Lead (Pb) free
   Board: Dimensions 40 x 40 mm (1600 mm^2 in one side)
   Copper (Cu) traces occupy 50% of the board area
   In top and back faces
   Package heat-sink is tied to the copper traces
   Material: Glass Epoxy (FR-4)
   Thickness: 1.6 mm
   Through-hole: 4 x 0.8 Diameter

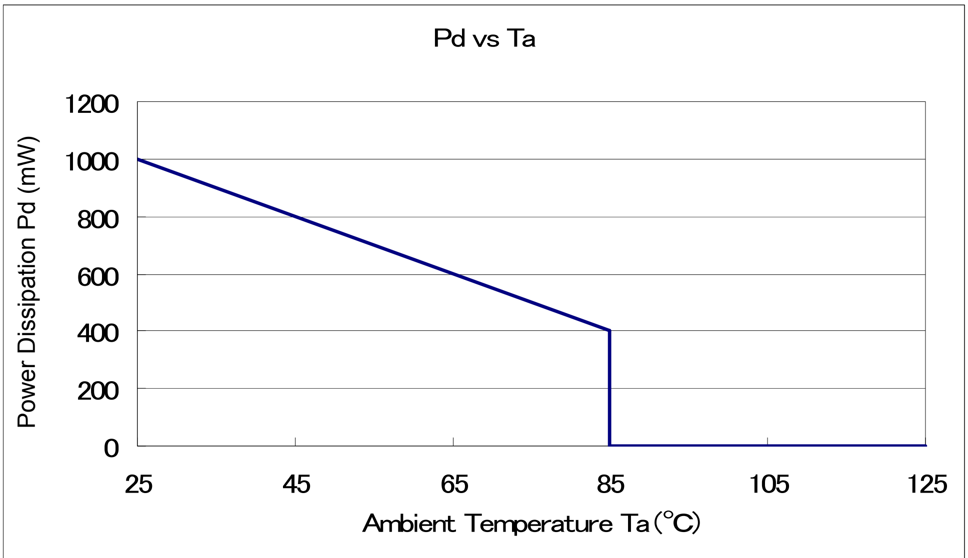


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

Ambient Temperature(℃)	Power Dissipation Pd(mW)	Thermal Resistance (℃/W)
25	1000	100.00
85	400	

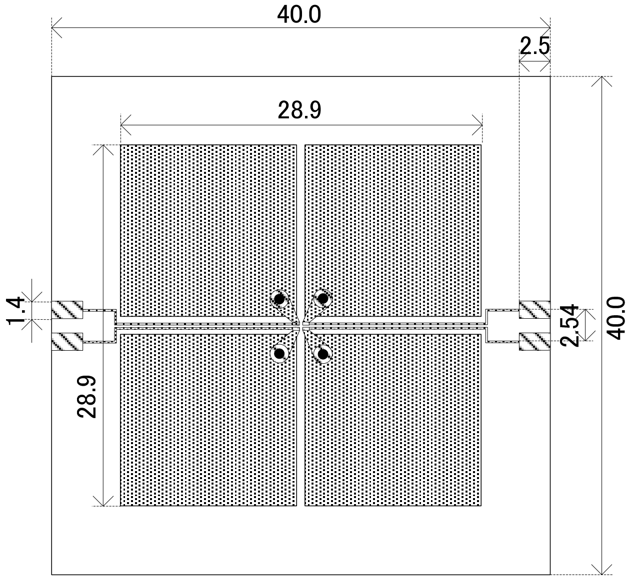


■PACKAGING INFORMATION (Continued)

● USPN-4 Power Dissipation

Power dissipation data for the USPN-4 is shown in this page.
The value of power dissipation varies with the mount board conditions.
Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)
   Condition: Mount on a board
   Ambient: Natural convection
   Soldering: Lead (Pb) free
   Board: Dimensions 40 x 40 mm (1600 mm^2 in one side)
   Copper (Cu) traces occupy 50% of the board area
   In top and back faces
   Package heat-sink is tied to the copper traces
   Material: Glass Epoxy (FR-4)
   Thickness: 1.6 mm
   Through-hole: 4 x 0.8 Diameter

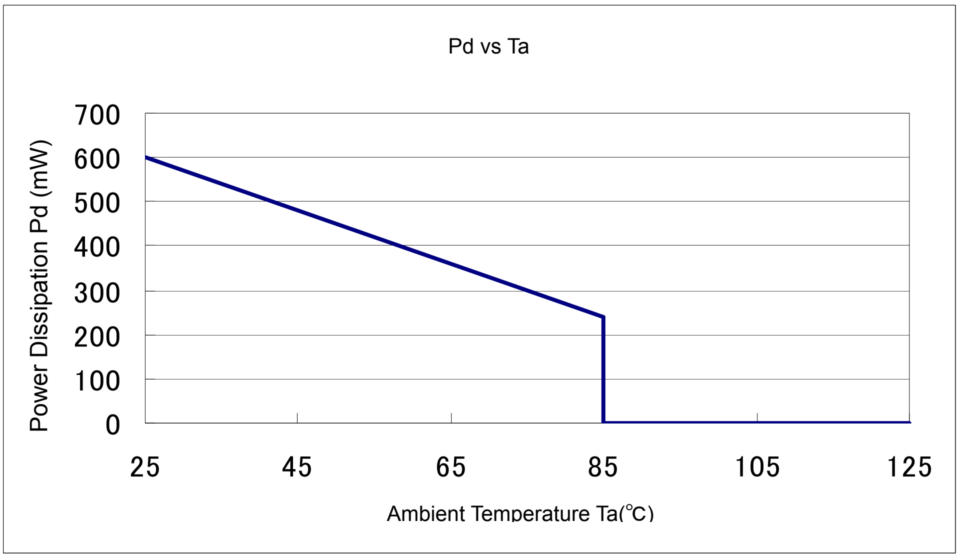


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient Temperature

Board Mount (Tj max = 125℃)

Ambient Temperature (℃)	Power Dissipation Pd (mW)	Thermal Resistance (℃/W)
25	640	166.67
85	240	



■MARKING RULE

●SOT-25、USP-4

① represents product series

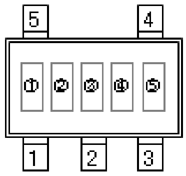
MARK	PRODUCT SERIES
C	XC8102******

② represents CE pin logic

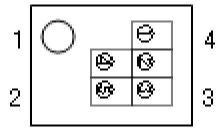
MARK	PRODUCT SERIES
F	XC8102A*****

③ represents C_L Discharge Function

MARK	PRODUCT SERIES
C	XC8102*A****



SOT-25
(TOP VIEW)



USP-4
(TOP VIEW)

④⑤ represents production lot number
01, …,09, 0A, …,0Z, 11,…,9Z, A1, …, A9, AA, …, Z9, ZA,…,ZZ repeated.
(G, I, J, O, Q, W excluded)
*No character inversion used.

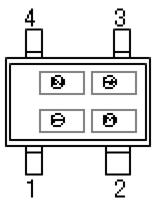
●SSOT-24、USPN-4

① represents product series

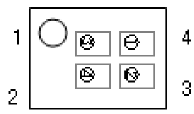
MARK	PRODUCT SERIES
C	XC8102******

② represents CE pin logic and C_L Discharge Function

MARK	PRODUCT SERIES
5	XC8102AA****



SSOT-24
(TOP VIEW)



USPN-4
(TOP VIEW)

③④ represents production lot number
01, …,09, 0A, …,0Z, 11,…,9Z, A1, …, A9, AA, …, Z9, ZA,…,ZZ repeated.
(G, I, J, O, Q, W excluded)
*No character inversion used.

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